

APPENDIX B

FIELD DATA CONSIDERATIONS

B-1. General. The collection of field data in an estuary is complicated by three factors: the dynamic nature and the size of estuaries and the importance of episodic events. Because of these factors, the importance of properly designing and executing a data collection program cannot be overstressed. Before actually designing a data collection program, the investigator should conduct the following tasks:

- a. Clearly define the overall scope of the project and list each basic task.
- b. Acquire as much information on the entire system as possible through the review of available data and literature.
- c. Clearly define the objectives or goals of the field data collection program.

Only after these above tasks have been addressed should the actual design of a field data collection program be undertaken. The size of an estuary usually requires that a large number of data collection locations be established, and its dynamic nature requires that the data be synoptic; i.e., collected simultaneously. Together, these two requirements suggest that a meaningful data collection program in an estuary is no small task.

B-2. Types of Prototype Measurements Needed. Typical prototype measurements in estuaries, along with the expected accuracy, purpose, and problems associated with each are summarized in Table B-1. As can be seen, there are nine main categories of data collection to address water resources activities.

TABLE B-1

Prototype Measurements in Estuaries

<u>Type/ Expected Accuracy</u>	<u>Purpose</u>	<u>Problems</u>
1. Water level ±0.05 feet	Tide ranges, datum references, tide propagation, constituents, extreme levels	Usually relative levels are adequately measured, but absolute levels often inadequate, expense of establishing gage zeroes.

(Continued)

TABLE B-1 (Continued)

Type/ Expected Accuracy	Purpose	Problems
2. Currents ±0.15 feet per second	Three-dimensional profile of current, speed, and direction (at least 2-dimensional in horizontal plane), net transport, maximum values, circulation	Low speeds, inadequate spatial coverage, near-bed measurements, wave interference, and survivability of instruments.
3. Bed stresses ±0.1 Newton/ square metre	Shear, pressure fluctuations	Shear must be inferred from velocities/slopes. Placement of pressure sensors is sometimes tricky.
4. Suspended sediments ±5 parts per million	Concentrations, settling velocities, transport rates	Difficult to obtain representative samples plus comments on currents apply.
5. Dissolved materials ±0.1 parts per thousand	Salinity, total dissolved solids	Comments on currents apply.
6. Bed elevation ±1.0 feet	Water depth, erosion/deposition	Accuracy is very poor, collection is complicated (density dredging, etc.).
7. Bed sediments	Rheology, density, erosional/depositional behavior, grain sizes, etc.	Sediment characteristics mainly inferred from minerology, etc., or obtained from lab experiments. Undisturbed measurement techniques are needed.
8. Freshwater Inflows 5 percent of flow	Analysis of salinity and freshwater supply.	Defining the boundary conditions and hydrodynamics

(Continued)

TABLE B-1 (Concluded)

Type/ Expected Accuracy	Purpose	Problems
9. Meteorologic Information National Weather Service standards	Effects of atmospheric pressure, wind, and surface waves.	Availability of reliable information which is site specific.

B-3. Field Measurements. There are six basic parameters that are typically field measured as part of a field investigation: tide heights and currents, suspended solids, salinity, and bed stresses and elevation. These measurements can be made on a short-term and a long-term basis, the short term usually referring to a period of 13 or 25 hours (one tidal cycle) and the long term from months to many years. Short-term surveys of 13 hours (semidiurnal tide) and 25 hours are sometimes referred to as intensive surveys. Typically, at least two short-term surveys are planned to support a model study (for two different river discharges or two different tidal conditions). Long-term surveys are usually required to conduct rigorous time series analysis of data. Because of the expense of long-term data collection, time series analysis is often limited to tide heights, although such analysis for other parameters is certainly advantageous.

B-4. Other. Factors that will influence the quality of the collected data include

- a. The expertise of personnel designing the program and collecting the data.
- b. Manpower and fiscal constraints, i.e., the number of collection sites versus the number of personnel involved in the collection process (fatigue must be considered when a small number of personnel collect data from numerous sites over a large area for an extended period of time).
- c. Collection platform: above-water (fixed) structure, boat, or moored (in situ) instrumentation.
- d. Meteorologic conditions during the survey.
- e. Freshwater inflow variability.
- f. Type and condition of sample equipment and instrumentation.
- g. Type and condition of laboratory sample processing equipment.
- h. Timeliness of sample processing.

i. Loss of or damage to moored equipment due to accident, foul weather, or vandalism.

j. Local cooperation.

B-5. Precaution Planning. Another area of consideration is that of precaution planning. In general, it is beneficial to have spare parts, extra instrumentation, and alternate plans should one or more of the factors adversely impact the data collection program. The loss of a meter or the mechanical failure of an outboard motor could mean the loss of critical data or perhaps no data at several stations. Attempting to gather this information at a later date would be costly and the additional data may not be consistent with the previous data. Equipment should be inspected regularly during a survey and maintained as needed.

B-6. Personnel Training and Experience. Substantial specialized experience and tidal hydraulics knowledge are required to collect estuarine field data successfully. Experience in inland water data collection is useful, but often insufficient to properly cope with the unique problems of highly unsteady, nonuniform flow and numerous important forcing functions in the estuarine environment. If the data are to be used to verify a model, it is also necessary for an experienced modeler to participate in planning and executing the field data collection so that the specific needs of the model are met. These factors plus the expense of estuarine data collection mandate that appropriately trained and experienced personnel plan and conduct these field programs.

B-7. Example Data Collection Program. The following example describes a short-term (13-hours) data collection effort conducted in the vicinity of Savannah Harbor, Savannah, Georgia (Johnson, Trawle, and Kee 1989). The prototype data were gathered in April 1985 by the US Army Engineer Waterways Experiment Station and the US Army Engineer District, Savannah, and were required to support a numerical model study of Savannah Harbor and vicinity. The objective of the numerical model investigation was to predict the impact of proposed channel deepening on maintenance dredging requirements and salinity intrusion.

B-8. The Savannah Estuary. The Savannah River estuary extends from the Atlantic Ocean to the northwest dividing the states of Georgia and south Carolina. It consists of a series of channels and loops, all interconnected, with the main navigation channel being North Channel and along Front River (Figure B-1). Located on Little Back River is the Savannah National Wildlife Refuge. A tide gate and a sediment trap are located on Back River (Figure B-1). During flood tide, the sediment-laden water flows upstream through the sediment trap with the tide gate open. During ebb, the gate is closed and the water in the Back River area is flushed down Front River. This results in higher ebb velocities in Front River and a decrease in shoaling along the Front River Channel. Tidal influence extends from the mouth upstream approximately 45 miles to Ebenezer Landing.

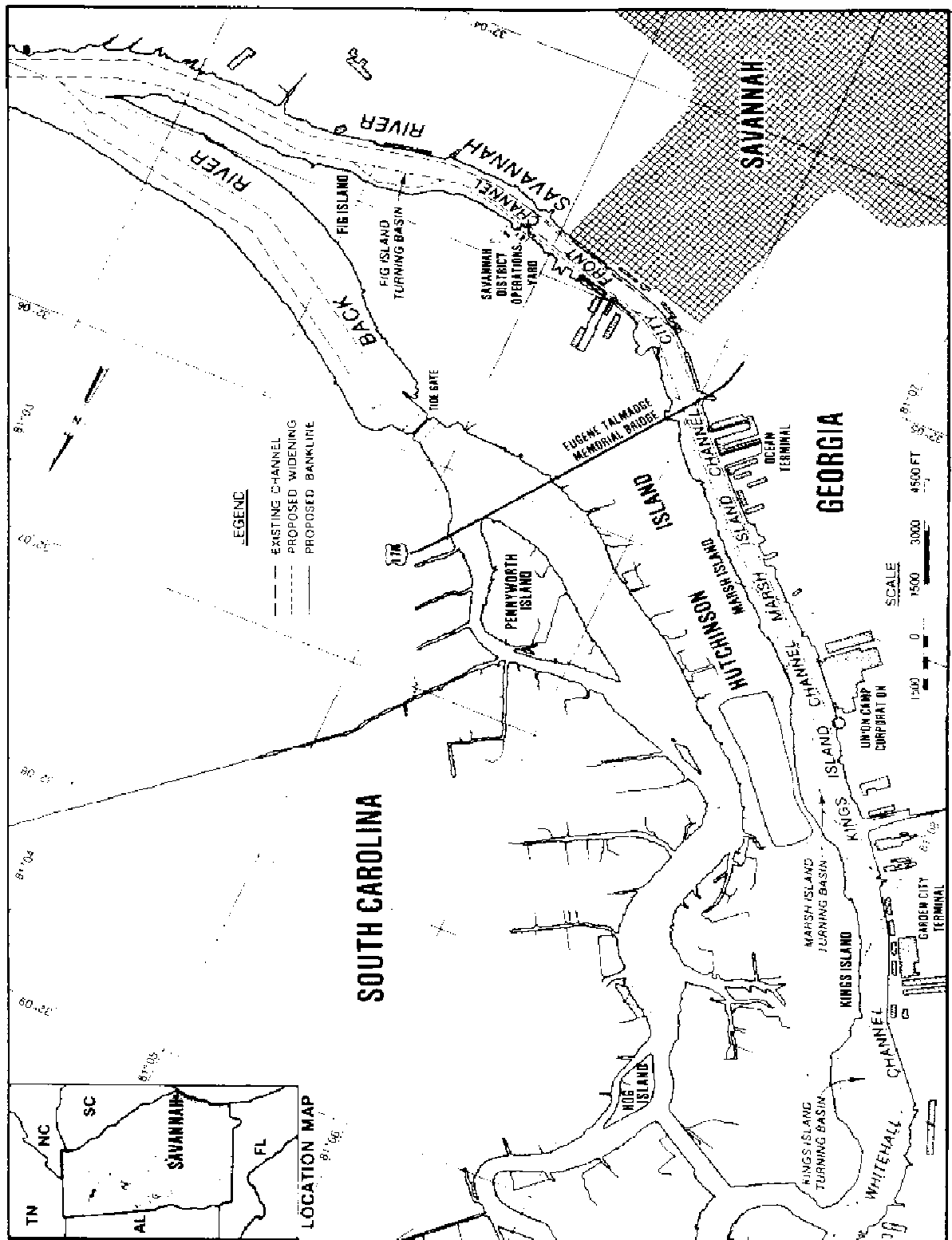


Figure B-1. Location map

B-9. Short-Term Survey Plan. During April 1985, an intensive 13-hour survey was conducted along the Savannah River from Fort Pulaski (river mile 0.0) upstream to Ebenezer Landing. The survey consisted of 12 ranges (Figure B-2), each with two or three stations located across the channel. Range 1 was located at Fort Pulaski. Ranges 2 and 3 and Ranges 5 through 7 were established along Front River. Range 4 was located in the sediment trap. Ranges 8, 8A, and 9 were located at Fields Cut, Elba Island Cut, and the Intracoastal Waterway Alternate Route, respectively. Ranges 10 and 11 were established along Little Back River and Range 12 was established at Ebenezer Landing. The locations were chosen to provide a range of data for sediment movement and changes in salinity. This range of data will allow a realistic model simulation of area conditions and changes as opposed to localized changes at the tide gate itself.

B-10. Actual Survey. The 13-hour survey was conducted on 4-5 April 1985 from 0600 to 1900 hour. During the survey, current velocity measurements were taken at 1-hour intervals along the left and right channel prism and along the center line of Ranges 1-6. Range 7 consisted of two transects, one along Front River near river mile 19.7 and another at the junction of Back and Front Rivers where measurements were taken at a single midchannel station. Velocity data are taken at several different depths at each station to determine sediment carrying capacity, distance carried, and also time and direction phasing. This is especially important in the near-bed region where various shear and frictional forces exist at the interface. Current velocity measurements were measured at five depths for each station at Range 1: surface, two-thirds above the bottom, middepth, one-third above the bottom, and 2 feet above the bottom. For Ranges 2 through 7 and Range 12, velocity data were collected at four depths: surface, middepth, 4 feet above the bottom, and bottom. At Ranges 8 through 11, velocity data were collected at three depths: surface, middepth, and bottom. Current velocity measurements were obtained with the use of a magnetic compass indicator and a Price-type current meter. A sample tube was attached to the meter and weight assembly, and water samples were collected to be analyzed later for salinity and suspended sediment concentration.

B-11. In addition to these intensive survey measurements, a number of bed samples were collected by grab sampler at various locations within the estuary to characterize the bed. Settling velocities of suspended sediments were also estimated during the intensive survey using a Niskin tube sampler.

B-12. Tide gages were installed at twelve locations within the estuary 1 month prior to the intensive survey and were in operation during the intensive survey as well as for 30 days preceding the survey.

B-13. Long-Term Survey. This example field survey obtained only 30 days of tide records for long-term data. Depending on the requirements of the study, availability of other data, and resource constraints, it may be necessary to collect other long-term data as part of the survey. For example, proper definition of tidal characteristics may require a minimum of 6 months record. (Twenty-nine years is commonly used for a rigorous determination of tidal

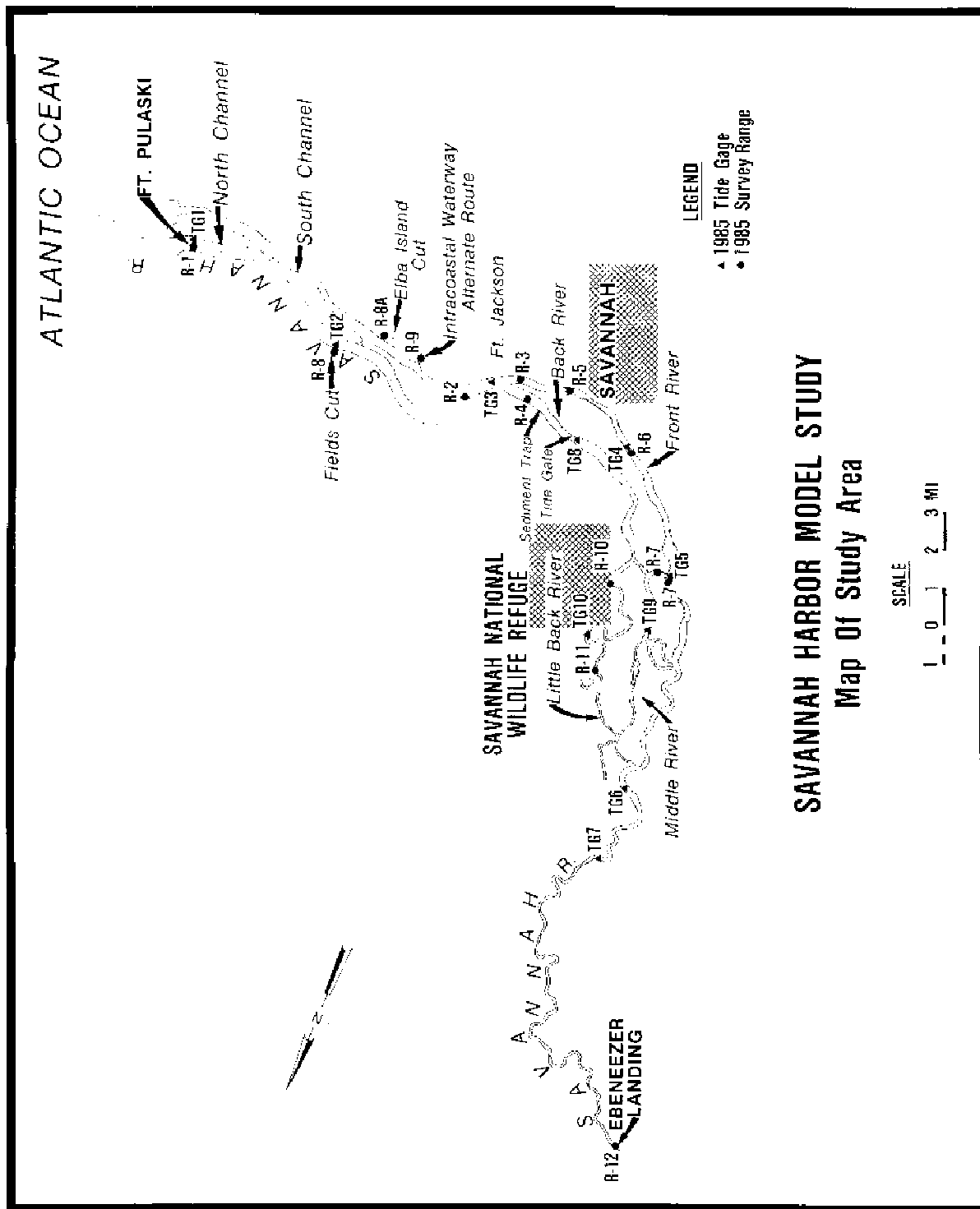


Figure B-2. Study location

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constituents.) Long-term (30 days to 1 year) velocity, temperature, conductivity, turbidity, wave, and/or meteorological measurements are often obtained to fully define seasonal and episodic event responses of the estuary. These data are collected by recording meters installed for weeks to months and left untended for extended (days to weeks) periods.

B-14. Other Collection Programs. The preceding discussion of the Savannah Harbor data collection program was just one example to indicate the level of complexity. The WES HL has conducted numerous data collection programs with cooperation of several Districts for other problem areas such as location of dredge disposal sites, fate of dredged materials, salinity intrusion, hydraulic transport of contaminated sediment, and other parameters of estuarine hydrodynamics. The locations of the field collection programs have included the east, Gulf, and west coasts, and their descriptions are given in various WES technical reports. Please refer to Appendix F or contact HL for specific information.